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Postglacial marine deposits and marine limit determinations, inner Wager Bay area, Kivalliq region, Nunavut

L.A. Dredge[1] and I. McMartin[1]

Dredge, L.A. and McMartin, I., 2005: Postglacial marine deposits and marine limit determinations, inner Wager Bay area, Kivalliq region, Nunavut; Geological Survey of Canada, Current Research 2005-B3, 5 p.

Abstract: This paper discusses postglacial marine features, including raised beaches and deltas, marine plains, and wave-erosion trimlines near the marine limit. Marine-limit measurements indicate that postglacial seas regionally inundated the area to an elevation of 110 m in the inner part of Wager Bay, and to about 95 m west of Brown Lake. Sporadic marine-limit elevations as low as 50 m correspond to areas with late-glacial ice. Marine shells at an elevation of 60 m yielded radiocarbon ages of about 5800 years.

Résumé : Le présent article discute des formes de terrain associées à la mer postglaciaire, notamment des plages et des deltas soulevés, des plaines marines et des encoches créées par l'érosion des vagues près de la limite maximale de transgression. Les mesures de la limite marine indiquent que les eaux marines ont envahi la région jusqu'à une élévation de 110 mètres dans la zone intérieure de la baie Wager, et de 95 mètres à l'ouest du lac Brown. L'observation de limites marines aussi basses que 50 mètres indique la présence d'une masse glaciaire résiduelle tardive dans les zones en question. Des coquillages marins récoltés à une élévation de 60 mètres ont rendu des âges radiocarbones d'environ 5800 ans.

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INTRODUCTION

This report briefly describes the nature, extent, and age of marine deposits near the head of Wager Bay, which lies in the region of Kivalliq on the west side of Hudson Bay (Fig. 1). The main focus is on marine-limit determinations. The marine limit is a term used to refer to the highest elevation reached by the postglacial sea. The elevation of the marine limit yields information about the extent of inundation by postglacial seas, the amount of postglacial crustal deformation, and for the mineral exploration industry, it indicates the elevation below which the geochemical composition of glacial deposits may have been altered by marine processes or by mixing of glacial materials with marine sediments.

The study is part of a GSC regional Quaternary project covering the Wager Bay map area (NTS 56 G), for which field mapping and till sampling were completed in 2004 (*see* Fig. 1 for location). Marine deposits described in this report are confined to the northern part of the map area, and adjacent areas to the north and east in the Walker Lake (NTS 56 J) and Douglas Harbour (NTS 56 H) map areas (Fig. 2).

Elevations within the area shown on Figure 2 range from sea level to a maximum height of about 611 m. The area consists of a lowland (<100 m elevation) that includes the head of Wager Bay, Ford Lake (elevation 1 m), Brown Lake (elevation 36 m), and adjacent plains that fringe these water bodies, particularly on their northern sides. South of Wager Bay, cliffs rise abruptly from the shore to a rolling rocky upland surface lying at an elevation of 400–500 m. North of Wager Bay, the land rises more gently to plateau elevations ranging from 200 m to 300 m.

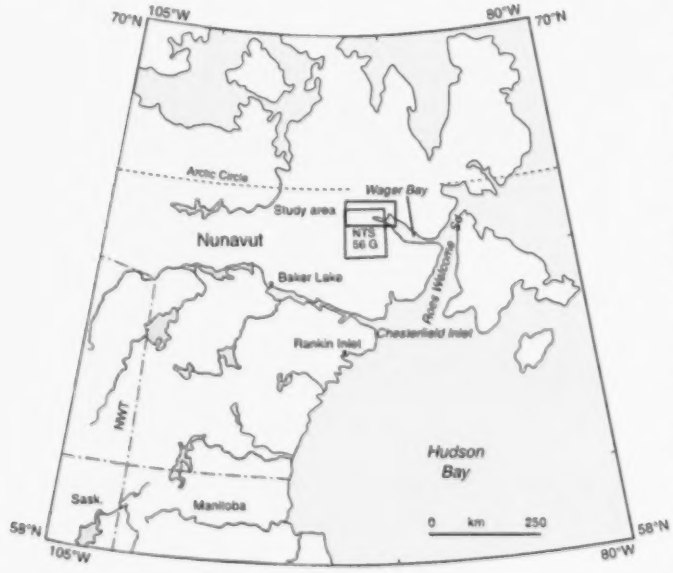

Figure 1. *Location of the study area and place names used in this report.*

FIELD WORK

Marine deposits and landforms were mapped and initially interpreted using 1:60 000 airphotos. Ground observations on marine features were made during the course of the more comprehensive regional mapping project. Elevations of features were recorded to a precision of 1 m using a Garmin™ GPS. The elevations determined by this method compared well with recent topographic maps that show 10 m contour intervals. The elevations are considered to be accurate to within ±5 m, or better.

RESULTS AND INTERPRETATION

Evidence for postglacial marine inundation is confined to the lowlands around Wager Bay, Ford Lake, and Brown Lake. Except for raised gravel beaches (Fig. 3), and deltaic sands forming terraces above present-day streams, marine deposits are generally thin, and are limited to the more gently sloping lowlands north of Wager Bay (Fig. 4) and Brown Lake (Fig. 5). Marine limit positions were determined by recording the elevations of raised deltas (Fig. 6) that indicate where meltwater streams and overflow channels from glacial lakes fed into high-level water bodies; ice-contact deltas, on which kettled surfaces are fronted by beach ridges (Fig. 7); and trimlines where the uppermost limit of wave erosion of glacial deposits is prominent (Fig. 8). It was found that marine limits determined by the limit of intense wave washing such as in Figure 8 were 5–10 m above the upper limit of raised beaches, and may result from storm surges or exceptionally high tides. The present tidal range seems to be about 4 m.

Marine-limit elevations across the study area are shown on Figure 2. A succession of meltwater deltas from streams flowing into Wager Bay from the south indicates that marine limits on the south shore stand at elevations of 110–115 m at the eastern part of the map area, and decline to 95 m in the central part of the area shown, and possibly to 80 m or 87 m in the west. North of Wager Bay, near the shores, marine limits are commonly at an elevation of about 95 m. These data suggest that the eastern part of the study area opened up first, and that the marine incursion followed rapidly into the rest of the area. In a few of the glacial troughs

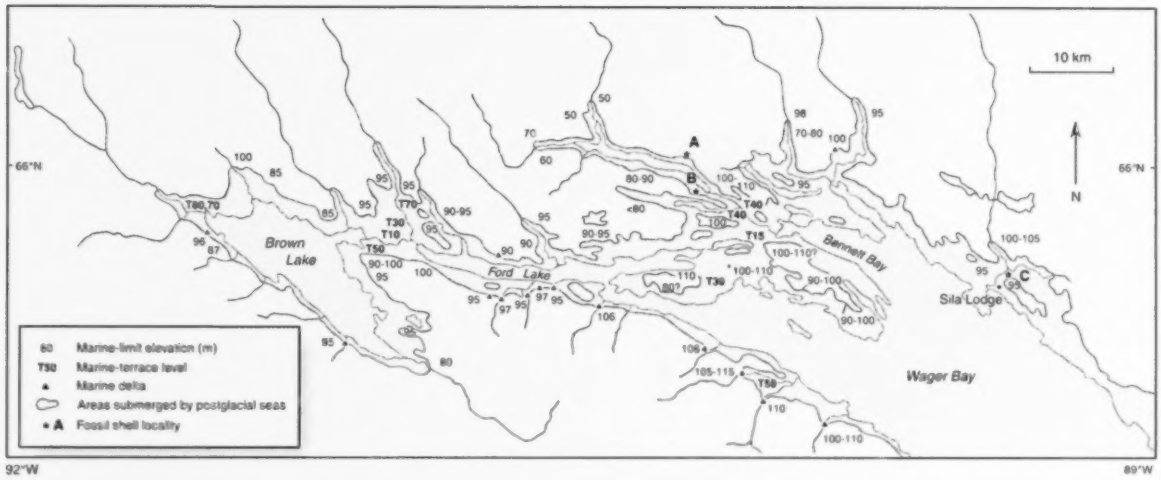

Figure 2. *Marine-limit elevations, fossil localities, and areas submerged by the postglacial sea.*

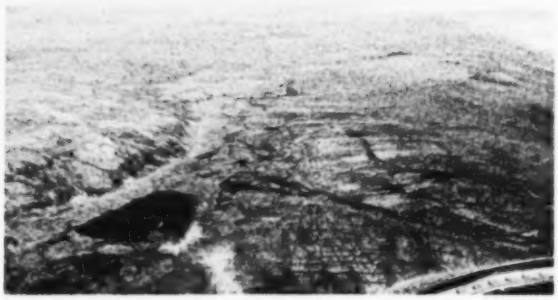

Figure 3. *Flights of gravel beaches on the north side of Wager Bay near Bennett Bay. Photograph by L.A. Dredge. GSC 2005-009*

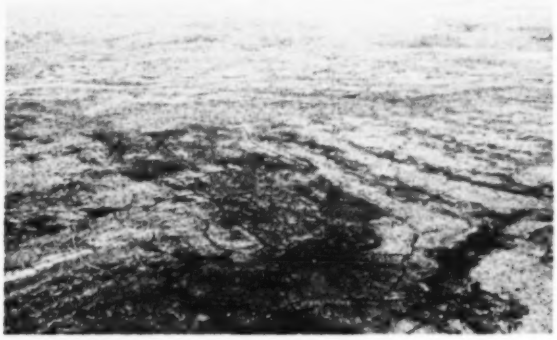

Figure 5. *Sandy marine plain with raised beaches and rectilinear ice-wedge polygons, station 04DU033, east of Brown Lake. Photograph by L.A. Dredge. GSC 2005-011*

Figure 4. *Grassy marine plains, outwash terraces, and rock knobs northwest of Bennett Bay. Photograph by J-F. Gagnon. GSC 2005-010*

Figure 6. *Raised gravel delta with topsets at an elevation of 106 m, south side of Wager Bay. Station 04DU004. Photograph by L.A. Dredge. GSC 2005-012*

Table 1. Radiocarbon dates. Letters refer to site locations on Figure 2.

Site	Elevation (m)	ID	Uncorrected age (years)	d^{13} (ppt)	Normalized (-25 ppt) age (years)	Species	Reference
A. North of Ford Lake	56	GSC-41	5470 ± 140	–	–	–	Dyck and Fyles (1963)
B. North of Ford Lake	56	GSC-6839	5750 ± 60	1.6	6170 ± 60	*Hiatella arctica*	This report
C. Sila River	60	GSC-6841	5870 ± 80	3.0	6320 ± 80	*Hiatella arctica, Mya truncata*	This report
– No data							

Figure 7. *Sandy esker ridge (right) and kettled outwash delta fronted by sandy beach ridges (left). Station 04DU024. Photograph by L.A. Dredge. GSC 2005-013*

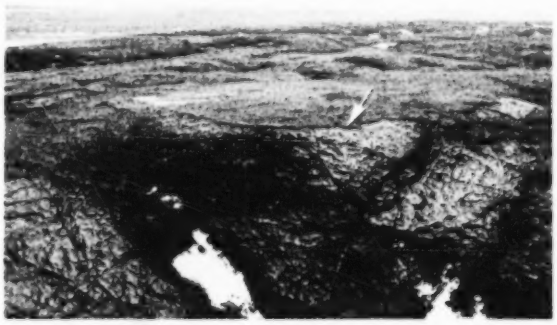

Figure 8. *Marine-limit trimline. The sharp contact between unmodified till and washed bedrock (arrow) marks a marine limit at 110 m. Station 04DU008. Photograph by I. McMartin. GSC 2005-014*

Figure 9. *Flat-topped delta north of Ford Lake, site B. Marine molluscs were collected from foreset sands exposed at this site. Station 04DU009. Photograph by I. McMartin. GSC 2005-015*

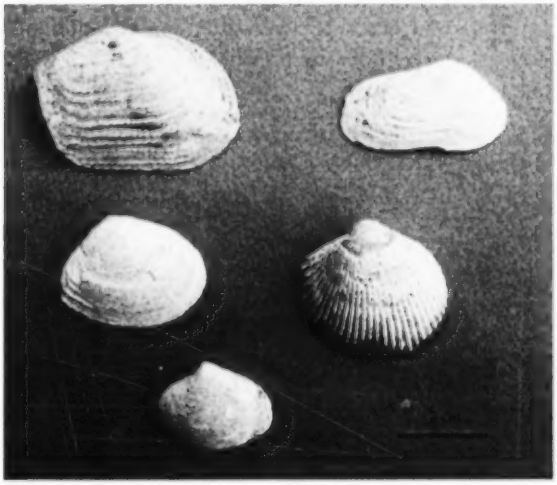

Figure 10. *Molluscs collected at site C north of Sila Lodge. Top:* Mya truncata *(left) and* Hiatella arctica *(right); middle:* Macoma calcarea *(left) and* Clinocardium ciliatum *(right); bottom:* Astarte borealis. *Station 04DU0122. Photograph by L.A. Dredge. GSC 2005-01*

north of Wager Bay, land above 50–80 m has not been inundated by the sea. In these locations, late ice tongues may have remained after coastal areas were ice-free. Similarly, the low marine-limit elevation southeast of Brown Lake (80 m) probably indicates a remnant ice mass in that area. This ice mass prevented drainage of late glacial lakes east of Brown Lake (Dredge and McMartin, 2005).

The area occupied by the postglacial sea is similar to, but somewhat more restricted than, the area shown on the *Glacial Map of Canada* (Prest et al., 1968). The elevation of marine limit shown on this glacial map is at an elevation of 132 m in the outer, eastern part of Wager Bay near Roes Welcome Sound (Fig. 1), and between 109 m and 115 m about halfway to the head of the bay. Bird (1954) reported a marine limit of 119–122 m in the outer bay, 110 m halfway in, and 116 m in the inner bay, the easternmost area shown on Figure 2; however, no data for Ford Lake or Brown Lake were previously shown. Our mapping indicates that wave-cut notches incised into the till surface north of Brown Lake occur at elevations 20–90 m higher than those depicted on Figure 2. Because these notches are less well developed and are less geographically consistent in elevation than known marine trimlines, they are thought to relate to glacial lakes (Dredge and McMartin, 2005).

RADIOCARBON DATES AND TIMING OF MARINE EVENTS

Marine molluscs are rare in this area. None were found in major ice-contact delta deposits. Shells were encountered at lower elevations in several small deltas (Fig. 9, 10) along what would have been sheltered embayments, as listed in Table 1 and shown on Figure 2. Curiously, all three sites lie at elevations between 50 m and 60 m, which could represent a time or conditions most favourable for entry or survival of marine fauna in the region. A date from a site north of Ford Lake (66°10'N (incorrect, should be 66°01'N); 90°14'W; site A, Table 1) on marine shells collected at 56 m by B.G. Craig gave an uncorrected age of 5470 ± 140 years (GSC-41; Dyck and Fyles (1963)). Shells collected by the present authors from foresets in two small deltas this past summer gave uncorrected ages of 5750 ± 60 years and 5870 ± 80 years, and normalized ages of 6170 ± 60 years and 6320 ± 80 years, respectively (Table 1). These dates provide information of the time when sea level stood near the respective elevations, and also give a minimum estimate of the time of deglaciation for the inner part of Wager Bay.

As a regional comparison, the marine limit along the west side of Roes Welcome Sound between outer Wager Bay and Chesterfield Inlet lies at about 150 m. Marine shells at 126 m gave an uncorrected age of 6830 ± 170 years (GSC-289; Craig (1965)) and indicate the approximate time of deglaciation of the outer part of Wager Bay. The lower marine limit in the inner part of Wager Bay and the younger dates at sites at 60 m elevation suggest that deglaciation of the inner bay occurred later and that the rate of uplift was slower.

CONCLUSION

This report shows the extent of postglacial marine inundation in the inner part of Wager Bay, and elevations for the marine limit. Marine fossils found in small deltas at about 60 m elevation yielded uncorrected ages of 5900–5500 years, and normalized ages of about 6300–6200 years.

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